



The Prevalence and Related Factors of Anterior Open Bite in Dental Patients of the Lower Northern Part of Thailand

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Abstract

The aim of this study was to determine the prevalence of anterior open bite and interpret its related factors. A cross-sectional study was carried out in 400 dental patients (169 males, 231 females, ages from 4 years, mean age 31 ± 21.9 years) who attended dental hospital, Naresuan university. The presence of anterior open bite and other factors was collected with clinical examination and history taking by one trained dentist. Ninety one patients (25.7%) presented anterior open bite. The patients aged 4–18 years presented the most prevalence compared with others. Logistic regression showed tongue-thrust swallowing and non-nutritive sucking were significantly related to anterior open bite with Odd ratio = 2.5 (1.302–5.933) and 3.5 (1.429–8.411) respectively. For relationship between anterior open bite and other types of malocclusion, we found spacing of maxillary incisors and large overjet were significantly related to anterior open bite with Odd ratio = 5.6 (2.093–14.929) and 1.6 (1.121–2.453) respectively. In conclusion, dental patients of the lower northern part of Thailand presented a high prevalence of anterior open bite which related to certain types of malocclusion and abnormal oral habits. Dentist should realize this high prevalence and emphasize the management of anterior open bite and its related factor which could be the main problem in dental treatment procedure.

Keywords: Prevalence, anterior open bite, Thailand

Introduction

Anterior open bite was defined by many authors. Proffit, Fields, Sarver, and Ackerman (2013) termed it as the failure of vertical overlap between maxillary and mandibular incisors in the textbook 'Contemporary Orthodontics'. It was also described as the condition that maxillary incisors failed to overlap the incisal third of mandibular incisors (Hak, Bevis, & Waite, 1984). This type of malocclusion provided the major challenge in orthodontic field including the facial esthetic, function such as speech disorder and biting problem, treatment planning, treatment mechanics and stability. The presence of this malocclusion was also associated with other types of malocclusion (Machodo et al., 2014). One of the most common related factor of anterior open bite was abnormal oral habits. Certain

habits might be a cause of anterior open bite (Bakor et al., 2010; Hanson & Andrianopoulos, 1982; Justus, 2001; Moyers, 1988). Moreover, persistent abnormal oral habits were considered as an important factor of relapse after anterior open bite correction (Huang, Justus, Kennedy, & Kokich, 1989; Justus, 2001).

Although many prevalent studies of anterior open bite were constructed worldwide with wide range from 1.5 to 12.1 % (Borzabadi-Ferahani, Borzabadi-Ferahani & Eslamipour, 2009; Ize-Iyamu & Isiekwe, 2012; Macho et al., 2012; O' Brien, 1993; Proffit, Fields, & Moray, 1998; Tang, 1994; Thilander, Pena, Infante, Parada, & de Mayorga, 2001; Woon, Thong, & Adul Kadir, 1989), the study in the lower northern part of Thailand has not been available yet. The related study, conducted in this region, reported the prevalence of abnormal oral



habits and the relation to malocclusion (Sasigornwong et al., 2016). This study was extended from mentioned study (Sasigornwong et al., 2016) to determine the prevalence of anterior open bite and interpret its related factors in the population of dental patients of the lower northern part of Thailand.

Methods and Materials

This cross-sectional study was submitted to and approved by Naresuan university ethical committee, Phitsanulok, Thailand (IRB No. 405/58). The size of population in the lower northern part of Thailand, collected from registry office, department of provincial administration, was about 6,317,178 people (Official statistics registration systems, 2014). According to Yamane (1967), sample size for precision of $\pm 5\%$ for population size over 100,000 people, the number of patients conducted in this study was 400 patients. The patients, who attended dental hospital, Naresuan university between November 2015 and April 2016, were selected with randomized-by-using-non-probability-sampling method. The inclusion criteria included the dentulous patients who reside in nine provinces of the lower northern part of Thailand (Kamphaeng Phet, Nakhon Sawan, Phetchabun, Phichit, Phitsanulok, Sukhothai, Tak, Uthai Thani and Uttaradit), ages from 4 years without history of orthodontic treatment, oro-facial trauma or surgery, mental retardation, active respiratory infection and active seasonal allergy. An informed consent form was signed by parents/caretakers in the case of patients aged under 12 years. For patients aged 13–20 years, the patients signed the informed consent form in agreement with their parents. The others signed the informed consent form by themselves.

The presence of malocclusion was obtained with clinical examination. Anterior open bite was diagnosed when the patients presented the failure of vertical overlap between maxillary and mandibular incisors (Proffit et al., 2013) whereas the failure of occlusion between maxillary and mandibular posterior teeth either unilateral or bilateral was diagnosed as posterior open bite (Proffit et al., 2013). When a space between maxillary incisors presented, spacing of maxillary incisors was diagnosed. Diagnosis of anterior crossbite was made when mandibular incisors located in front of maxillary incisors. Posterior crossbite was diagnosed when maxillary posterior teeth were positioned buccally or lingually compared with mandibular posterior teeth (Moyers, 1988). Large overjet was diagnosed when horizontal overlap between maxillary and mandibular incisors was greater than 3 mm (Proffit et al., 2013).

The abnormal oral habits which was investigated in this study included non-nutritive sucking, mouth-breathing, tongue-thrust swallowing and nail-biting. The presence of these habits was obtained with history taking by using a questionnaire and clinical examination. For examples, mouth-breathers were diagnosed with the test of Rashmdeep's method (Prajapati & Nayak, 2013) and the modified method of Weiss and Van Houten was used for diagnosis of tongue-thrust swallowers (Weiss & Van Houten, 1972).

Clinical examination methods and the questions in history taking form were verified by group of experts in associated fields (orthodontics, pediatric dentistry and occlusion) with content validity index of 0.84. The reliability for 10% of test-retest Kappa score was 0.92. All data was assessed by one trained dentist (Post-graduate student in Master of Science-orthodontic division). All collected data was analyzed with computer program; SPSS (Version 17.0



Copyright) 1993–2007, SPSS Inc., Chicago, United States of America. The report of the prevalence of anterior open bite and abnormal oral habits was obtained with descriptive statistics. Logistic regression was used to interpret the relationship and quantify how strong of that relationship between anterior open bite and other factors. For example, how strong of the relationship between anterior open bite and an abnormal oral habit was obtained by using the number of patients who presented anterior open bite without the habit as the reference compared with the number of patients who presented anterior open bite with the habit, then the

calculated data was shown in term of odd ratio (OR). All statistics were conducted with 95% confident interval (P -value < 0.05).

Results

A total of 400 patients, 169 were males and 231 were females. Ages of the patients were classified into 5 groups followed by the modified method of Havighurst's Developmental task theory (Havighurst, 1972). Table 1 showed the distribution of patients according to ages and sexes in this study.

Table 1 Distribution of patients according to ages and sexes

	Male N (%)	Female N (%)	Total N (%)	Mean age \pm SD
Childhood (4-12)	47 (58.8)	33 (41.2)	80 (20)	8.3 \pm 2.6
Adolescence (13-18)	28 (35.0)	52 (65.0)	80 (20)	16.0 \pm 1.7
Early adulthood (19-29)	35 (43.8)	45 (56.2)	80 (20)	21.8 \pm 3.0
Middle adulthood (30-60)	26 (32.5)	54 (67.5)	80 (20)	43.6 \pm 10.0
Elderly person (over 60)	33 (41.3)	47 (58.7)	80 (20)	66.4 \pm 5.4
Total	169 (42.3)	231 (57.7)	400 (100)	31.2 \pm 21.9

Ninety one patients (25.7%) presented anterior open bite. The most prevalence was found in adolescence group with 40.0% of patients. The

prevalence of anterior open bite according to ages and sexes was shown in Table 2.

Table 2 Prevalence of anterior open bite according to ages and sexes

	Male N (%)	Female N (%)	Total N (%)
Childhood (4-12)	2 (4.4)	6 (18.0)	8 (10.4)
Adolescence (13-18)	10 (35.7)	22 (42.3)	32 (40.0)
Early adulthood (19-29)	16 (45.7)	13 (28.9)	29 (36.3)
Middle adulthood (30-60)	1 (4.8)	9 (18.4)	10 (14.3)
Elderly person (over 60)	2 (11.1)	10 (34.5)	12 (25.5)
Total	31 (21.1)	60 (29.0)	91 (25.7)



The most prevalent habit was tongue-thrust swallowing which was found more than a half of all patients (62.3%). The prevalence of abnormal oral habits according to ages and sexes was shown in Table 3.

Table 3 Prevalence of abnormal oral habits according to ages and sexes

	Number of patients presenting abnormal oral habits (N (%))											
	Non-nutritive sucking			Mouth-breathing			Tongue-thrust swallowing			Nail-biting		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Childhood (4-12)	11 (23.4)	6 (18.9)	17 (21.3)	10 (21.3)	7 (21.2)	17 (21.3)	32 (68.1)	24 (72.7)	56 (70.0)	8 (17.0)	14 (42.4)	22 (27.5)
Adolescence (13-18)	2 (7.1)	3 (5.8)	5 (6.3)	4 (14.3)	9 (17.3)	13 (16.3)	18 (64.3)	33 (63.5)	51 (63.8)	5 (17.9)	8 (15.4)	13 (16.3)
Early adulthood (19-29)	1 (2.9)	6 (13.3)	7 (8.8)	3 (8.6)	10 (22.2)	13 (16.3)	19 (54.3)	30 (66.7)	49 (61.3)	1 (2.9)	7 (15.6)	8 (10.0)
Middle adulthood (30-60)	0	0	0	1 (3.8)	5 (9.3)	6 (7.5)	14 (53.8)	28 (51.9)	42 (52.5)	0	3 (5.6)	3 (3.8)
Elderly person (over 60)	0	0	0	3 (9.1)	5 (10.6)	8 (10.0)	16 (48.5)	35 (74.5)	51 (63.8)	1 (3.0)	0	1 (1.3)
Total	14 (8.3)	15 (6.5)	29 (7.3)	21 (12.4)	36 (15.6)	57 (14.3)	99 (58.6)	150 (64.9)	249 (62.3)	15 (8.9)	32 (13.9)	47 (11.8)

To interpret the relationship between anterior open bite and other independent variables, logistic regression showed that there was no statistically significant difference in sexes. However, the childhood and adolescence groups (4-18 years) were related to anterior open bite. In addition, there were relationships between anterior open bite and

certain abnormal oral habits. The presence of tongue-thrust swallowing and non-nutritive sucking were related to anterior open bite about 2.5 times (OR = 2.363, CI = 1.302-5.933) and 3.5 times (OR = 3.467, CI = 1.429-8.411) respectively. These relationships were shown in Table 4.

**Table 4** Logistic regression for anterior open bite and independent variables

Variables			Anterior open bite			
			N	OR	95% CI	P value
Sexes	Male	ref	31			
	Female		60	0.781	0.435-1.494	0.405
Ages	> 60 yrs.	ref	12			
	30-60		10	1.044	0.395-2.762	0.125
	19-29		29	1.243	0.483-3.196	0.109
	4-18		37	4.301	1.818-10.172	0.001*
Non-nutritive sucking	No (ref)		18			
	Yes		47	3.467	1.429-8.411	0.006*
Mouth breathing	No (ref)		20			
	Yes		41	0.554	0.269-1.141	0.109
Tongue thrust	No (ref)		13			
	Yes		68	2.363	1.302-5.933	0.000*
Nail-biting	No (ref)		43			
	Yes		17	0.987	0.457-2.132	0.652

* Level of significance at $p < 0.05$

The relationships between anterior open bite and various types of malocclusion were shown in Table 5. Spacing of maxillary incisors and large overjet

were related to anterior open bite about 5.6 times (OR = 5.590, CI = 2.093-14.929) and 1.6 times (OR = 1.641, CI = 1.121-2.453) respectively.

Table 5 Logistic regression for anterior open bite and various types of malocclusion

Variables		Anterior open bite			
		N	OR	95% CI	P value
Posterior open bite	No (ref)	5			
	Yes	8	0.987	0.457-2.132	0.974
Spacing of maxillary incisors	No (ref)	14			
	Yes	18	5.590	2.093-14.929	0.001*
Anterior crossbite	No (ref)	14			
	Yes	25	0.554	0.269-1.141	0.481
Posterior crossbite	No (ref)	4			
	Yes	6	0.707	0.162-3.074	0.644
Large overjet	No (ref)	9			
	Yes	44	1.641	1.121-2.453	0.021*

* Level of significance at $p < 0.05$



Discussion

Many factors were reported to be the causes of anterior open bite. Genetic could promote vertical growth in molar region then resulted anterior open bite. Environmental factors especially abnormal oral habits, which generated forces to anterior teeth, could also be a cause of anterior open bite (Ngan & Fields, 1997).

Previous studies reported the prevalence of anterior open bite in various population which ranged 1.5 to 12.1 % (Borzabadi-Ferahani et al., 2009; Ize-Iyamu & Isiekwe, 2012; Macho et al., 2012; O' Brien, 1993; Proffit et al., 1998; Tang, 1994; Thilander et al., 2001; Woon et al., 1989). Almost twenty six percent of patients presenting anterior open bite in this study was higher than mentioned studies. This varied prevalence might be due to difference in races, regions, inclusion criteria and also the definitions of anterior open bite used in the studies. In addition, forty percent of adolescence with anterior open bite in this study was the highest prevalence among various studies constructed in samples with similar age ranges (Borzabadi-Ferahani et al., 2009; Proffit et al., 1998; Woon et al., 1989). We also found that the patients aged 4-18 years presented the most prevalence of anterior open bite compared with other age groups. This result corresponded to the previous studies which reported that anterior open bite was mainly found in mixed (Machodo et al., 2014) and primary dentition patients (Urzal, Braga, & Ferreira, 2013). Interestingly, although most of previous studies were constructed in young patients or about 2-20 years of age (Borzabadi-Ferahani et al., 2009; Ize-Iyamu & Isiekwe, 2012; Macho et al., 2012; O' Brien, 1993; Proffit et al., 1998; Tang, 1994; Thilander et al., 2001; Woon et al., 1989), our result showed that the older patients also presented high prevalence of anterior open bite. However, there was no data to compare.

The relationships between anterior open bite and other factors were reported in various studies. Our study found non-nutritive sucking and tongue-thrust swallowing were related to anterior open bite. Similar results were found in many studies (Ize-Iyamu & Isiekwe, 2012; Ng, RWK, & Hagg, 2007; Straub, 1960; Urzal et al., 2013) such as the study of Urzal et al. (2013) that reported pacifier-sucking, thumb-sucking, tongue-thrust swallowing and mouth-breathing were a major risk factor of anterior open bite and the study of Ize-Iyamu and Isiekwe (2012) that reported the most important etiology of anterior open bite was thumb-sucking which was a non-nutritive sucking.

In the view of relationship between anterior open bite and other types of malocclusion, The patients with large overjet had a higher chance of presenting the anterior open bite (Machodo et al., 2014). Labial tipping of maxillary incisors and lingual tipping of mandibular incisors were reported as a cause of anterior open bite (Moyers, 1988). The relationship between anterior open bite and large overjet was also found in this study. Furthermore, we found that spacing of maxillary incisors was related to this type of malocclusion.

Ages of the patients might be a factor related anterior open bite. In this study we found the relationship between anterior open bite and the childhood and adolescence groups. This might be due to the influence of non-nutritive sucking which was mostly found in young patients. However, there was no data to compare.

Since anterior open bite was one of the major problem in dental treatment such as difficulty in orthodontic treatment mechanics, high relapse rate after orthodontic treatment (Denison, Kokich, & Shapiro, 1989) and its association with other types of malocclusion and abnormal oral habits which should be managed to increase success in treatment result and stability (Huang et al., 1989; Justus,



2001), this high prevalence should be concentrated by dentists to increase awareness of the presence of this malocclusion. Moreover, this result could be used to remind patients and parents to avoid related factors of anterior open bite that lead to need of orthodontic treatment.

Conclusion and Suggestion

Dental patients of the lower northern part of Thailand presented a high prevalence of anterior open bite which related to high prevalence of non-nutritive sucking and tongue-thrust swallowing. This type of malocclusion also related to other types of malocclusion including spacing of maxillary incisors and large overjet. Dentists should pay more attention to anterior open bite and its related factors which could be the main problem in dental treatment procedure.

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